Claims

1. An apparatus for detecting a wavelength of electromagnetic radiation, the apparatus comprising:

a first electromagnetic radiation detector (17) for receiving a first proportion of electromagnetic radiation that has been redirected from a main electromagnetic radiation path;

a second electromagnetic radiation detector (18) for receiving a second proportion of electromagnetic radiation that has been redirected from the main electromagnetic radiation path;

a third electromagnetic radiation detector (30) for receiving a third proportion of electromagnetic radiation that has been redirected from the main electromagnetic radiation path;

a filter (21) arranged for filtering the second proportion of the electromagnetic radiation before it reaches the second electromagnetic radiation detector;

an interferometric device (23) arranged for causing the third proportion of the electromagnetic radiation to interfere with itself before it reaches the third electromagnetic radiation detector; and

processing means (31) coupled to receive a first signal from the first electromagnetic radiation detector (17) indicating an intensity of the first proportion of the electromagnetic radiation detected by the first electromagnetic radiation detector (17), a second signal from the second electromagnetic radiation detector (18) indicating an intensity of the second proportion of the electromagnetic radiation from the filter (21) detected by the second electromagnetic radiation detector (18) and a third signal from the third electromagnetic radiation detector (30) indicating an intensity of the third proportion of the electromagnetic radiation from the interferometric device (23) detected by the third electromagnetic radiation detector (30), the processing means (31) determining a wavelength of the

electromagnetic radiation based on the ratios of the first and second signals and the first and third signals.

2. An apparatus as claimed in claim 1, wherein said filter is a broadband filter.

3. An apparatus as claimed in either claim 1 or claim 2, further comprising at least one electromagnetic radiation splitter (13) arranged in the main path of the electromagnetic radiation for redirecting said first proportion of the electromagnetic radiation to the first electromagnetic radiation detector (17) and for redirecting said second proportion of the electromagnetic radiation to the filter (21).

4. An apparatus as claimed in any one of the preceding claims, wherein said interferometric device (23) comprises a block of material that can transmit electromagnetic radiation, the block having a partially transmissive input face (24), an at least partially internally reflective output face (25) and a pair of at least partially internally reflective side faces (26, 27), such that said third proportion of electromagnetic radiation can, in use, partially externally reflect from and partially transmit through the input face, at least partially internally reflect from said output face, at least partially internally reflect from said side faces, and at least partially transmit back through the input face so as to interfere with the part that externally reflects from the input face.

5. An apparatus as claimed in claim 4, wherein said interferometric device forms said electromagnetic radiation splitter, the interferometric device being arranged in the main electromagnetic radiation path for redirecting said first proportion of the electromagnetic radiation to the first electromagnetic radiation detector, for redirecting said second proportion of the electromagnetic radiation to the filter and for redirecting said third

proportion of the electromagnetic radiation such that it interferes with itself and is directed to the third electromagnetic radiation detector.

6. An apparatus as claimed in either claim 4 or claim 5, wherein said interferometric device is formed of at least two conjoined sub-blocks of electromagnetic radiation transmitting material, so that the input and output faces of the interferometric device are formed from faces of the different sub-blocks, each sub-block having coatings of different reflective and transmissive characteristics formed thereon, whereby at least the input and output faces of the interferometric device have different reflective and transmissive characteristics on different areas thereof.

7. An apparatus as claimed in claim 6, wherein at least one of said coatings provided on at least part of the output face of the interferometric device has a wavelength dependent transmission characteristic to form said filter.

8. An apparatus as claimed in any one of claims 4 to 7, wherein dimensions of the block are predetermined so that a portion of electromagnetic radiation incident on the input face of the block at an input area is internally reflected by the output face a predetermined number of times, so as to exit the block at the input area and interfere with the electromagnetic radiation incident on the input face of the block and externally reflected thereby, the predetermined number of times being determined according to the required spacing of interference peaks required at the third electromagnetic detector.

9. An apparatus as claimed in any one of the preceding claims, wherein said processing means compares the ratio of the first signal and the second signal with predetermined values to determine an approximate wavelength of the electromagnetic radiation, and compares the ratio of the

first signal and the third signal with predetermined values to determine a more exact value for the wavelength of the electromagnetic radiation.

10. An apparatus as claimed in any one of claims 4 to 8, wherein said input face (35) of the block (32) is partially coated with a coating (50) that introduces a phase shift into part of said third proportion of the electromagnetic radiation, the third electromagnetic radiation detector (54) having at least two separate detectors for detecting respectively the part of said third proportion of the electromagnetic radiation that has been phase shifted by the coating and the part of said third proportion of the electromagnetic radiation that has not been so phase shifted, wherein said third signal is provided by one of the two separate detectors.

11. An apparatus as claimed in claim 10, further comprising a look-up table stored in a memory coupled to the processing means (31) having stored therein information regarding which of the two separate detectors is to be used as the third signal, depending on the wavelength to be determined.

12. A laser wavelength locking apparatus comprising a laser for emitting electromagnetic radiation along a main electromagnetic radiation path, an apparatus for detecting a wavelength of electromagnetic radiation emitted along said main electromagnetic radiation path according to any one of the preceding claims, a laser temperature controller coupled to the processing device for adjusting the temperature of the laser depending on the detected wavelength of the electromagnetic radiation emitted by the laser.

13. A method of detecting a wavelength of electromagnetic radiation, the method comprising the steps of:

receiving a first proportion of electromagnetic radiation that has been redirected from a main electromagnetic radiation path;

receiving a second proportion of electromagnetic radiation that has been redirected from the main electromagnetic radiation path via a filter;

receiving a third proportion of electromagnetic radiation that has been redirected from the main electromagnetic radiation path via an interferometric device so as to interfere with itself;

processing a first signal indicating an intensity of the first proportion of the electromagnetic radiation and a second signal indicating an intensity of the filtered second proportion of the electromagnetic radiation to provide a ratio of the first and second signals;

processing the first signal and a third signal indicating an intensity of the interfered third proportion of the electromagnetic radiation to provide a ratio of the first and third signals; and

utilising the ratios of the first and second signals and the first and third signals to determine a wavelength of the electromagnetic radiation.

14. A method of detecting a wavelength of electromagnetic radiation according to claim 13, further comprising the step of redirecting said first proportion of the electromagnetic radiation to a first electromagnetic radiation detector and of redirecting said second proportion of the electromagnetic radiation to the filter.

15. A method of detecting a wavelength of electromagnetic radiation according to either claim 13 or claim 14, wherein said interferometric device comprises a block of material that can transmit electromagnetic radiation, the block having a partially transmissive input face, an at least partially internally reflective output face and a pair of internally reflective side faces, the method comprising the step of redirecting said third proportion of electromagnetic radiation onto the input face of the block so that it is partially externally reflected from and partially transmitted through

the input face, at least partially internally reflected from said output face, internally reflected from said side faces, and transmitted back through the input face so as to interfere with the part that is externally reflected from the input face.

16. A method of detecting a wavelength of electromagnetic radiation according to any one of claims 13 to 15, wherein said utilising step comprises comparing the ratio of the first signal and the second signal with predetermined values to determine an approximate wavelength of the electromagnetic radiation, and comparing the ratio of the first signal and the third signal with predetermined values to determine a more exact value for the wavelength of the electromagnetic radiation.

17. A method of detecting a wavelength of electromagnetic radiation according to any one of claims 13 to 15, wherein part of said third proportion of the electromagnetic radiation is phase shifted with respect to another part so that the third signal comprises a pair of phase shifted third signals and said step of processing the first signal and the third signal to provide a ratio of the first and third signals comprises processing the first signal and a predetermined one of the pair of phase shifted third signals.

18. A method of locking the wavelength of electromagnetic radiation emitted by a tunable laser, the method comprising the steps of:

emitting electromagnetic radiation from a tunable laser along a main electromagnetic radiation path;

detecting a wavelength of electromagnetic radiation emitted along said main electromagnetic radiation path utilising the method of any one of claims 13 to 17; and

adjusting a temperature of the laser depending on the detected wavelength of the electromagnetic radiation emitted by the laser.

19. An interferometric device (32) comprising a block of material that can transmit electromagnetic radiation, the block having a partially transmissive input face (35), an at least partially internally reflective output face (36) and a pair of at least partially internally reflective side faces (37, 38), such that electromagnetic radiation incident on the input face (35), in use, partially externally reflects from and partially transmits through the input face (35), at least partially internally reflects from said output face (36), at least partially internally reflects from said side faces (37, 38), and at least partially transmits back through the input face (35) so as to interfere with the part that externally reflects from the input face (35).

20. An interferometric device as claimed in claim 19, which is formed of at least two conjoined sub-blocks (33, 34) of electromagnetic radiation transmitting material, so that the input (35) and output (36) faces of the interferometric device are formed from faces of the different sub-blocks (33, 34), each sub-block having coatings of different reflective and transmissive characteristics formed thereon, whereby at least the input and output faces of the interferometric device have different reflective and transmissive characteristics on different areas thereof.

21. An interferometric device as claimed in either claim 19 or claim 20, wherein dimensions of the block are predetermined so that a portion of electromagnetic radiation incident on the input face of the block at an input area is internally reflected by the output face a predetermined number of times, so as to exit the block at the input area and interfere with the electromagnetic radiation incident on the input face of the block and externally reflected thereby, the predetermined number of times being determined according to the required spacing of interference peaks of the electromagnetic radiation.

22. An interferometric device as claimed in any one of claims 19 to 21, wherein said partially transmissive input face (35) is provided over part of its surface with a coating that introduces a phase shift into the electromagnetic radiation that at least partially transmits back through the input face (35) and the part that externally reflects from the input face (35).

23. A method of causing electromagnetic radiation to interfere, the method comprising the steps of:

providing an interferometric device according to any one of claims 19 to 22;

directing the electromagnetic radiation onto the input face, so that it partially externally reflects from and partially transmits through the input face, at least partially internally reflects from said output face, internally reflects from said side faces, and transmits back through the input face so as to interfere with the part that externally reflects from the input face.

24. A method of fabricating an interferometric device according to any one of claims 19 to 22, the method comprising the steps of:

conjoining at least two sub-blocks of electromagnetic radiation transmitting material, so that the input and output faces of the interferometric device are formed from faces of the different sub-blocks, each sub-block having coatings of different reflective and transmissive characteristics formed thereon, whereby at least the input and output faces of the interferometric device have different reflective and transmissive characteristics on different areas thereof.

25. A method of fabricating an interferometric device according to claim 24, wherein the step of conjoining the two sub-blocks of electromagnetic radiation transmitting material comprises the steps of:

applying a curable cement between the faces of the sub-blocks to be conjoined;

adjusting the relative positions of the sub-blocks so that the electromagnetic radiation that internally reflects within the block is substantially aligned with the electromagnetic radiation that reflects from the input face so as to interfere therewith; and

curing the cement while the sub-blocks are fixed in the adjusted relative positions.

26. A method of fabricating an interferometric device according to claim 25, wherein the step of adjusting comprises passing the electromagnetic radiation into the block and measuring the interference pattern while adjusting the relative positions of the sub-blocks until the interference pattern is optimal.

27. A method of fabricating an interferometric device according to either claim 25 or claim 26, wherein the curable cement is an ultra-violet light curable optical cement having a refractive index matching the sub-blocks.